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SPRING MIGRATION OF WATERFOWL IN THE NORTH ARM OF GREAT SLAVE LAKE, 1989

Jacques Sirois
Susan E. Westover

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ABSTRACT

Spring aerial surveys of migrating waterfowl were conducted at 14 sites in the North Arm of Great Slave Lake. In 1989, the timing of spring break-up was similar to that of two of the last three years. Almost 34 700 birds were recorded. Scaup[1] were the most abundant birds followed by Tundra Swans, Canada Geese and 23 other species of waterfowl. At least 1% of the national population of Tundra Swans staged in the study area, hence its status as a Key Habitat Site for the Northwest Territories. Large numbers of Canvasbacks and sightings of other "prairie" species suggest that many drought-displaced birds occurred in the Great Slave Lake region in 1989. Waterbirds were particularly abundant in the lower Beaulieu River, at Goulet and Campbell bays, and in the lower Yellowknife River. Migration peaked in mid-May. By using a visibility correction factor, we estimate that over 11 000 birds were present in the study area on 16 May alone. The study area encompasses less than half of the North Arm's wetlands.

RÉSUMÉ

On a mené des inventaires aériens de sauvagine pendant la migration printanière, à 14 endroits dans le Bras Nord du Grand Lac des Esclaves. La chronologie de la fonte des glaces en 1989 fut semblable à celle de deux des trois derniers printemps. On a dénombré près de 34 700 oiseaux. Les oiseaux les plus communs furent les morillons, les Cygnes siffleurs et les Bernaches du Canada. Vingt-trois autres espèces de sauvagine furent aussi dénombrées. Au moins 1% de la population nationale de Cygnes siffleurs fut observé, d'où la reconnaissance du Bras Nord comme un site clé (Key Habitat Site) pour cette espèce dans les Territoires du Nord-Ouest. Un grand nombre de Morillons à dos blanc et la présence d'autres espèces typiques des prairies nous font croire que la sécheresse a favorisé le déplacement de plusieurs oiseaux vers le nord. Les oiseaux furent particulièrement abondants dans le bas de la rivière Beaulieu, dans les baies Goulet et Campbell, et dans le bas de la rivière Yellowknife. Le nombre d'oiseaux a culminé à la mi-mai. Si l'on corrige nos données avec un coefficient de visibilité, on estime que plus de 11 000 oiseaux étaient présents dans la région survolée le 16 mai. Cette région comprend moins de la moitié des marais du Bras Nord.

[1] Scientific names of all species are given in Appendix 1.

TABLE OF CONTENTS

ABSTRACT.....i

RÉSUMÉ.....i

LIST OF FIGURES.....ii

LIST OF TABLES.....iii

LIST OF APPENDICES.....iii

1.0 INTRODUCTION.....1

2.0 STUDY AREA.....1

3.0 METHODS.....6

4.0 RESULTS AND DISCUSSION.....8

4.1 Abundance of spring migrants.....8

4.2 Spatial and temporal distributions of spring migrants.....11

5.0 CONCLUSION.....15

6.0 LITERATURE CITED.....18

LIST OF FIGURES

Figure Page

1. Location of the North Arm of Great Slave Lake.....2

2. Location of open-water sites and the survey route between the lower Yellowknife River and François Bay.....3

3. Mean daily temperatures at Yellowknife during spring break-up, 1989.....5

4. Temporal distribution of migrating waterfowl at six control sites between Yellowknife Bay and François Bay,.....11

5. Relative importance of each open-water site to migrating waterfowl, Spring 1989.....14

LIST OF TABLES

Table — Page

1. Ice conditions between Yellowknife Bay and François Bay, Spring 1989....4

2. Total records and peak numbers of each species observed at all sites between Yellowknife Bay and François Bay, Spring 1989....9

3. Percent abundance of the ten most common species at each open-water site between Yellowknife Bay and François Bay, Spring 1989....13

4. Temporal abundance of migrating species between Yellowknife Bay and François Bay, Spring 1989....16

LIST OF APPENDICES

Appendix — Page

1. Scientific names of bird species mentioned in this report...19

2. Abundance of migrating species between Y llowknife Bay and François Bay, Spring 1989....20

3. Relative importance and amount of open water at each staging site, 1986-1989....25

1.0 INTRODUCTION

In response to a proposal to develop a mine at Thor Lake, near Great Slave Lake, the Canadian Wildlife Service (CWS) carried out spring surveys of waterfowl along the northeast shore of the North Arm in 1986, 1987 and 1988 (Sirois and McCormick 1987, Sirois 1987, Sirois and Cameron 1989). Extensive wetlands where ice-free waters appear early, and where large numbers of waterbirds concentrate, occur on the north shore of the North Arm. Fourteen sites were surveyed between Yellowknife Bay and the East Arm (Fig. 1; Appendix 3) and their relative importance was determined. Because more than 1% of the national population of Tundra Swans staged in that area, it was designated a Key Habitat Site for the Northwest Territories (Alexander and McCormick, in prep.).

Waterbirds are particularly abundant in the North Arm during spring and fall migrations but large flocks of moulting waterfowl also occur during the summer (J.S., pers. obs.). However, waterbirds are easier to survey in the spring because they are in breeding plumage and are easy to identify from an aircraft. Also, the birds congregate in few areas where there is open water. As in the past, spring surveys were carried out in 1989 to determine the relative abundance of all waterfowl species, as well as their spatial and temporal distributions at 14 sites along the northeast shore of the North Arm. The status of the area as a Key Habitat Site was also reassessed.

2.0 STUDY AREA

The study area and its climate have been described in Sirois and McCormick 1987. In 1989, the study area was modified by adding the lower Yellowknife River and dropping the Thor Lake area (15 km east of François Bay, north of Hearne Channel; Fig. 2). The latter site was poorly used by birds in 1986-1988. Ice conditions during spring break-up are summarized in Table 1 and mean daily temperatures are shown in Figure 3. In the first half of May 1989, break-up proceeded more or less as in 1986 and 1987, but unlike 1988, which

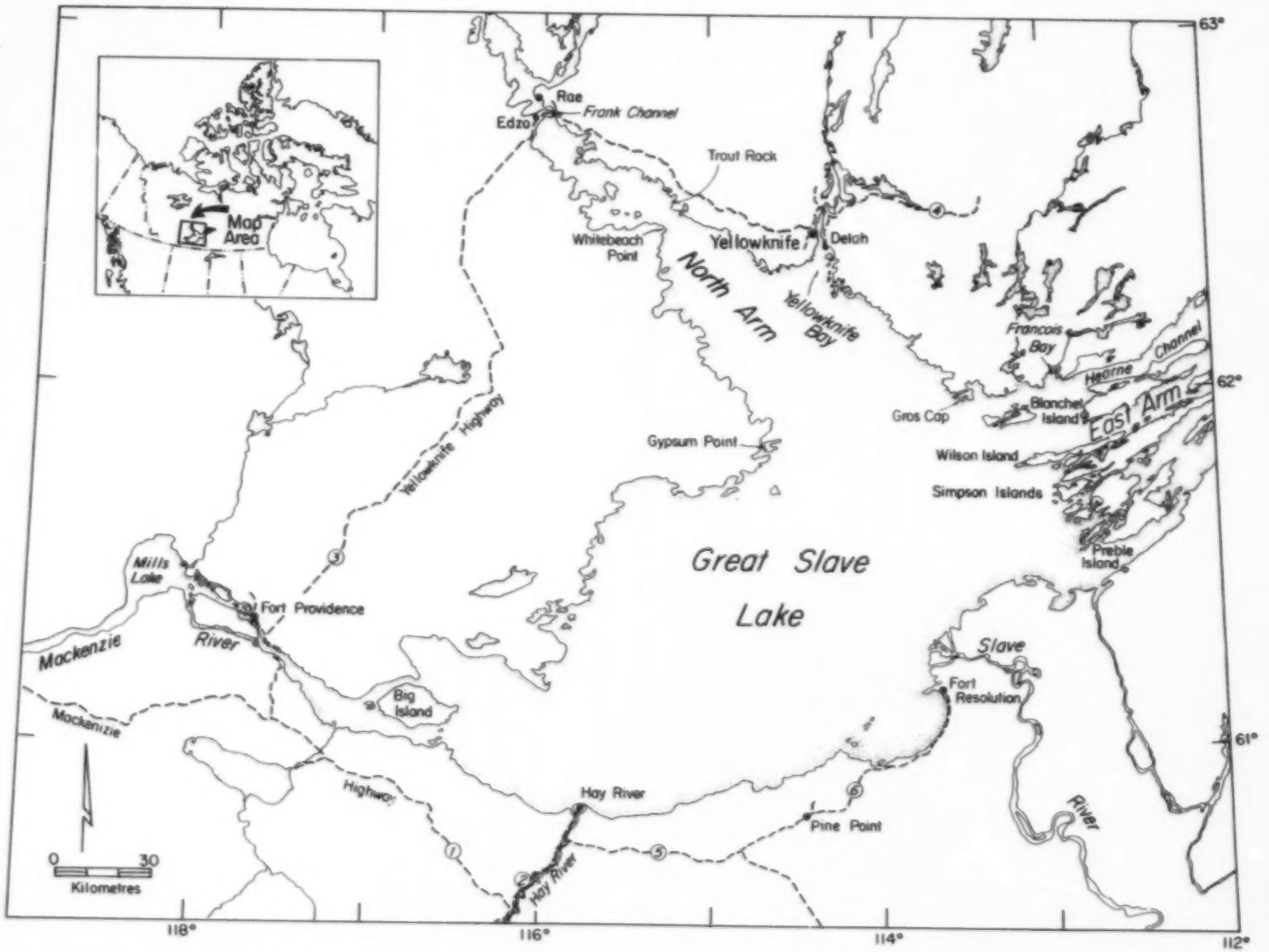

Figure 1. Location of the North Arm of Great Slave Lake.

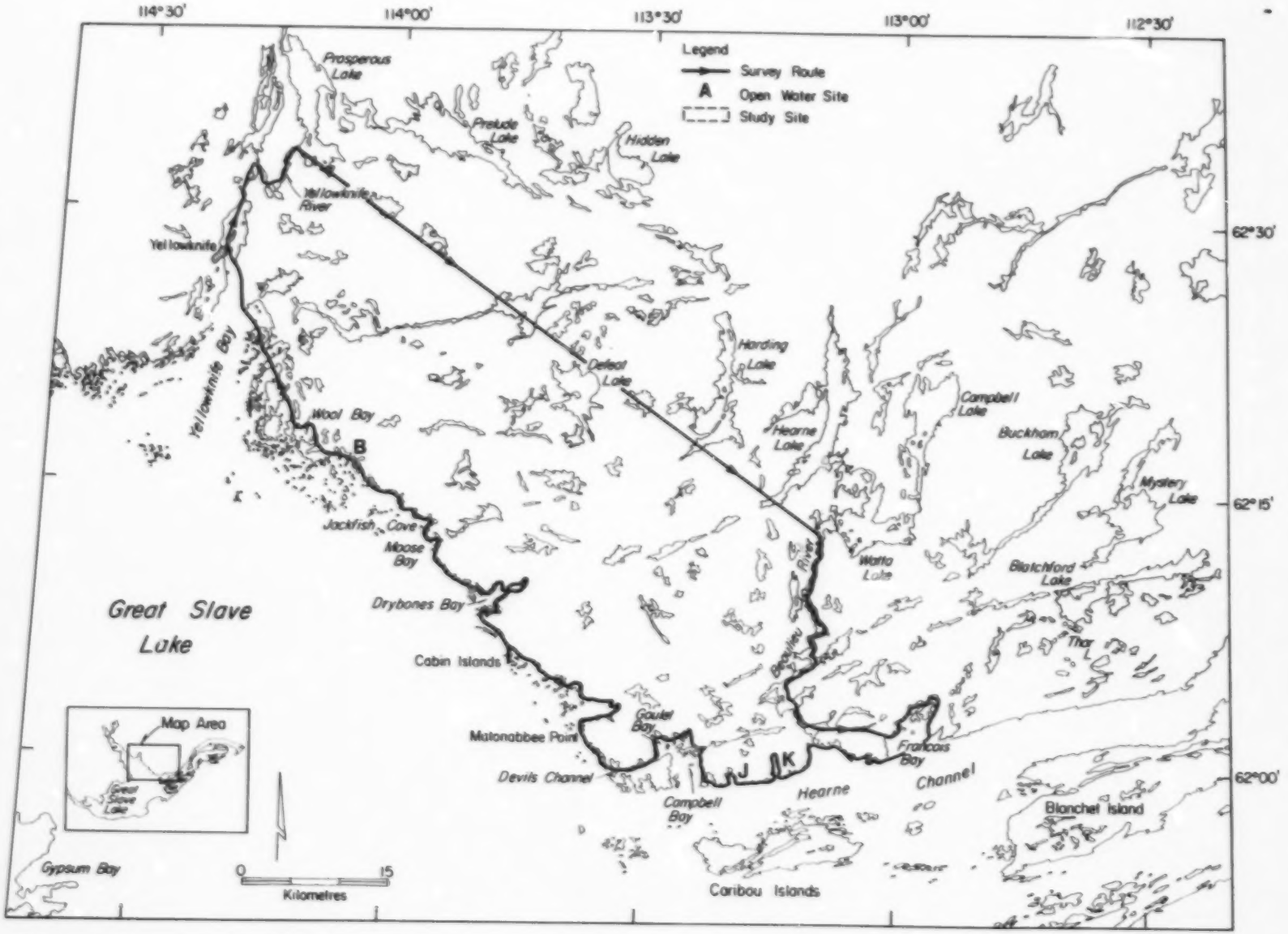

Figure 2. Location of open-water sites and the survey route between the lower Yellowknife River and François Bay.

Table 1. Ice conditions between Yellowknife Bay and François Bay, Spring 1989.

May	Ice conditions	Comments
10	Shallows around most islands are open but ice is still landfast along most shorelines. Wetlands in the shallow end of all bays are ice-free. Shore leads are 1-3 m wide in some locales. Wide sections of Yellowknife and Beaulieu rivers are still frozen.	There is a surprising amount of ice-free water despite cool temperatures. There is more ice on the lower Beaulieu River than on the lower Yellowknife River. Only traces of snow are left on the ground.
13	Many ponds and small lakes of the Precambrian Shield are entirely ice-free; larger lakes have shoreleads 5-7 m wide. Ice is dislocated in the shallows of Drybones Bay. Much of Devil's Channel is still frozen. Ice jams on Yellowknife River. Still much landfast ice in François Bay.	More open water; fewer traces of snow on the ground.
16/17	All wetlands at the end of each bay and shallows near islands are widely ice-free. Shore leads more than 10 m wide at Cabin Islands.	Rain showers have accelerated the melt.
19	Small lakes and some larger lakes adjacent to Great Slave Lake are entirely ice-free. Shoreleads are more than 20 m wide at most locations. Beaulieu River is almost entirely ice-free.	Melting is proceeding quickly. Open water is abundant.
22	Most small bays are ice-free. Shallow parts of large bays are ice-free. Shore leads are 50 m wide at Cabin Islands.	Melting is proceeding quickly.
27	Yellowknife and Beaulieu rivers are entirely ice-free. Large bays such as Drybones Bay are almost ice-free. Large lead more than 1 km wide in Great Slave Lake, off Matonabbee Bay.	Melting is proceeding quickly.
30	Devil's Channel is ice-free. Large lead in Great Slave Lake extends from Devil's Channel to Drybones Bay.	Too much water for satisfactory surveying; birds are often too far from the observer to be identified.

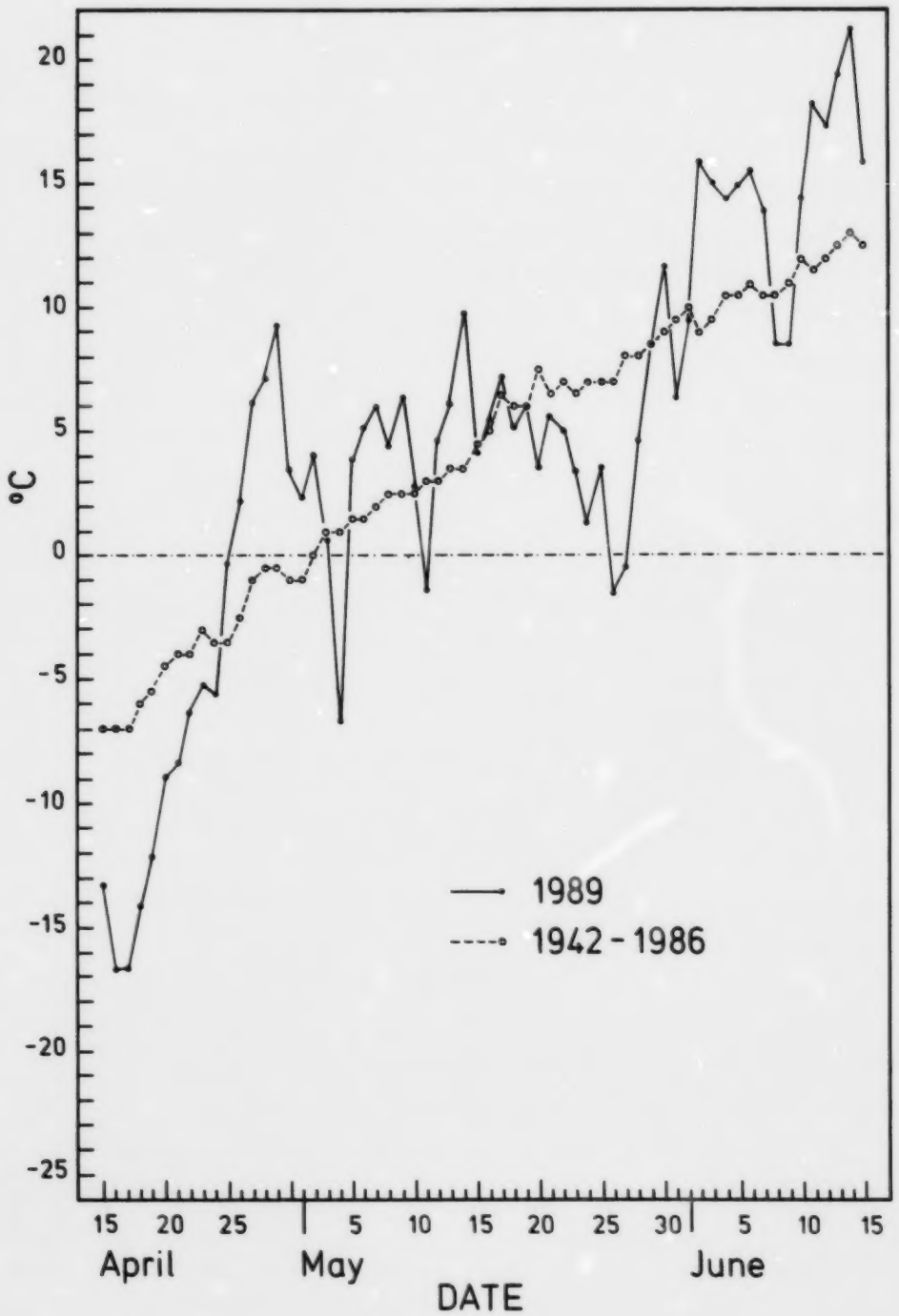

Figure 3. Mean daily temperatures at Yellowknife during spring break-up, 1989.

was a late spring. However, in the second half of the month, temperatures were below average but did not delay the break-up noticeably as they remained mostly above 0^0C.

3.0 METHODS

Seven aerial surveys were conducted by J. Sirois during the spring migration at 14 sites (Appendix 2) along the northeast shore of the North Arm, from the lower Yellowknife River to François Bay (Fig. 2). The surveys were conducted at three-day intervals, weather permitting, between 10 and 30 May. On 16 May, fog prevented the completion of the survey, which was finished the following day. The flight scheduled for 25 May was delayed until 27 May because of bad weather. The surveys were terminated on 30 May because the number of birds had declined noticeably and the areas of open water became too large for satisfactory surveying. Ice-free waters were surveyed at each site and all birds were recorded irrespective of their distance from the flight path. All surveys were flown in a PA-18 Piper Supercub, at approximately 125 km/h and 20-30 m above ground level.

All sightings were recorded on tape and subsequently transferred onto forms. Loons, grebes and all species of ducks, geese and swans were recorded. Given the paucity of information on Great Slave Lake's avifauna, birds of prey, and uncommon waterbirds were recorded but not taken into account when calculating the relative importance of each site to waterfowl. Common species of larids, albeit frequently observed, were ignored.

The relative importance of the 14 sites was determined by calculating the percent of the observations of the ten most common species (overall) at each site. The percentage values were then summed to yield an Index of Importance for a given site.

Aerial surveys usually underestimate animal numbers (Stott and Olson 1972, Caughley 1974, Savard 1982) because they are subject to biases such as the observer's identification skills, observer

fatigue, similarities in bird plumages[2], angle of prevailing light, ice conditions and albedo, different reactions of bird species to aircraft disturbance, and different patterns of habitat use among species[3]. In order to minimize the effects of these biases, we flew twice over areas where the observer felt it was needed. Also, before most surveys, visits were made by boat to the lower Yellowknife River to gain familiarity with the birds, their habitats and the newly-arrived species. Despite numerous limitations, we believe that the following figures are comparable to those from previous years and give an acceptable account of the spring migration.

No specific visibility correction factor is available for this region with respect to waterbirds during spring migration. However, if we attempt to determine the number of birds staging in the area, ground observations from the North Arm suggest that the use of a correction factor of 2.0, as used by Stott and Olson (1972) for wintering waterfowl, yields a conservative estimate of these birds. In contrast, we believe that the figures can be used without correction for the larger and more visible species, such as geese and swans.

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[2] As Greater Scaup and Lesser Scaup were impossible to differentiate from the air, they were lumped as Scaup spp.. Ring-necked Ducks may also have been identified as scaup if they occurred in the same flocks. Ross's Geese may have been present in the flocks of Snow Geese. Greater White-fronted Geese and Canada Geese occurred regularly in mixed flocks and may have been confused on some occasions.

[3] For example, divers are easier to detect than dabblers because they forage in open waters rather than in emergent vegetation.

4.0 RESULTS AND DISCUSSION

4.1 Abundance of spring migrants

Almost 34 700 birds[4] of 32 of species, including 26 species of waterfowl, were recorded during the seven surveys (Table 2). A peak of 7 200 birds[5] was recorded on 16 May. Twenty-five percent of the birds were scaup, followed by Tundra Swan (20%), Canada Geese (12%), American Wigeon (9%), Northern Pintail (8%), Canvasback (5%), Surf Scoter and Greater White-fronted Goose (4%), Mallard (2%) and Red-breasted Merganser (1%).

Scaup spp. have consistently been the most commonly recorded species in the last four years. In 1986-1989, they represented 25%, 20%, 24% and 25% of the total count, respectively. Although we do not know what fraction of these migrating scaup breed in this region, the Lesser Scaup is nonetheless the most common breeding duck in the Yellowknife area (Can. Wildl. Serv., unpub. data). The Greater Scaup also breeds commonly, particularly in Great Slave Lake (see Sirois et al. 1989).

The Tundra Swan was the second most common species. A peak of 1 344 swans was recorded on 22 May. Although this represents only a fraction of the swans that staged in the study area, it represents ca. 1% of the national population (Anon. 1986). A peak of 1 382 and 1 653 swans were recorded in 1987 and 1988, respectively. Accordingly, the designation of the North Arm as a Key Habitat Site for this species remains valid.

Record numbers of Canvasbacks were seen in 1989. Total numbers (and peak numbers) of Canvasbacks have steadily increased in 1986-1989. They were 71 (40), 376 (98), 679 (227) and 1 176 (585) respectively, excluding sightings from the Thor Lake area (not

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[4] Birds that did not leave the study area between surveys were likely counted more than once.

[5] Not corrected by a visibility factor.

Table 2. Total records and peak numbers of each species observed at all sites between Yellowknife Bay and François Bay, Spring 1989.

Species	Total records	%[a]	Peak numbers[b]
Red-throated Loon	5	+	3
Pacific Loon	16	0.1	7
Common Loon	78	0.2	23
Horned Grebe	12	+	6
Red-necked Grebe	403	1.2	218
Tundra Swan	7002	20.2	1344
Greater White-fronted Goose	1256	3.6	540
Snow Goose	307	0.9	105
Canada Goose	4204	12.1	1583
Green-winged Teal	11	+	4
Mallard	668	1.9	157
Northern Pintail	2754	7.9	651
Northern Shoveler	54	0.2	19
American Wigeon	3091	8.9	703
Canvasback	1834	5.3	1098
Redhead	5	+	3
Ring-necked Duck	73	0.2	20
Unidentified scaup	8478	24.5	1717
Oldsquaw	70	0.2	30
Black Scoter	5	+	3
Surf Scoter	1295	3.7	316
White-winged Scoter	2	+	2
Common Goldeneye	87	0.2	21
Bufflehead	265	0.8	64
Common Merganser	76	0.2	55
Red-breasted Merganser	504	1.4	156
Unidentified duck	2068	6.0	509
Osprey	1	+	1
Bald Eagle	38	0.1	9
Red-tailed Hawk	1	+	1
American Coot	2	+	1
Parasitic Jaeger	6	+	6
Caspian Tern	8	+	4
Total	34679	100.0	

[a] + = percentages <0.05

[b] Peak number of each species seen during one flight; peaks occurred on different dates.

surveyed in 1989) and the lower Yellowknife River (not surveyed in 1986-1988). If records from the lower Yellowknife River are included, 1 834 Canvasbacks were recorded in 1989, with a peak of 1 098 birds on 13 May. On that day, hundreds of additional Canvasbacks were observed from the air on waterbodies off the survey route. This increase in Canvasbacks is likely related to the drought on the Prairies (see Dickson 1990). Canvasbacks numbers increased by 72% in Alaska between 1988 and 1989 (Anon. 1989). In the study area (excluding Yellowknife River and Thor Lake) we recorded a 73% increase in total sightings, or a 158% increase in peak numbers, between 1988 and 1989. Canvasback counts from waterfowl population surveys in boreal Canada indicate an increase of 189% between 1985-1989 (Dickson 1990). Also, a preliminary review of the number of Canvasback broods found in the Yellowknife Waterfowl Study Area (located in the Precambrian Shield near Yellowknife) reveal that 44% of the Canvasbacks broods recorded in 1985-1989 occurred in 1989 (Can. Wildl. Serv., unpub. data).

A few American Coots and Redheads were also sighted for the first time since 1986. Respectively listed as occasional and rare in the region (Bromley and Trauger, no date), these species were also seen by ground observers in the Yellowknife Waterfowl Study Area and at other sites in the North Arm in 1989. Furthermore, nests of American Coots, Gadwalls, Ruddy Ducks and Black Terns were found near Yellowknife in 1989. The two former species are rare breeders locally whereas evidence of breeding for the two latter species had never been found prior to 1989. These records with those of Wilson's Phalarope, Yellow-headed Blackbird, and Cinnamon Teal reported in 1988 (see Sirois and Cameron 1989) suggest that many Prairie bird species move northward into the Northwest Territories in response to drought on the Prairies.

The relative abundance of all birds staging in the study area in 1989 compared to past years is depicted in Figure 4. This figure

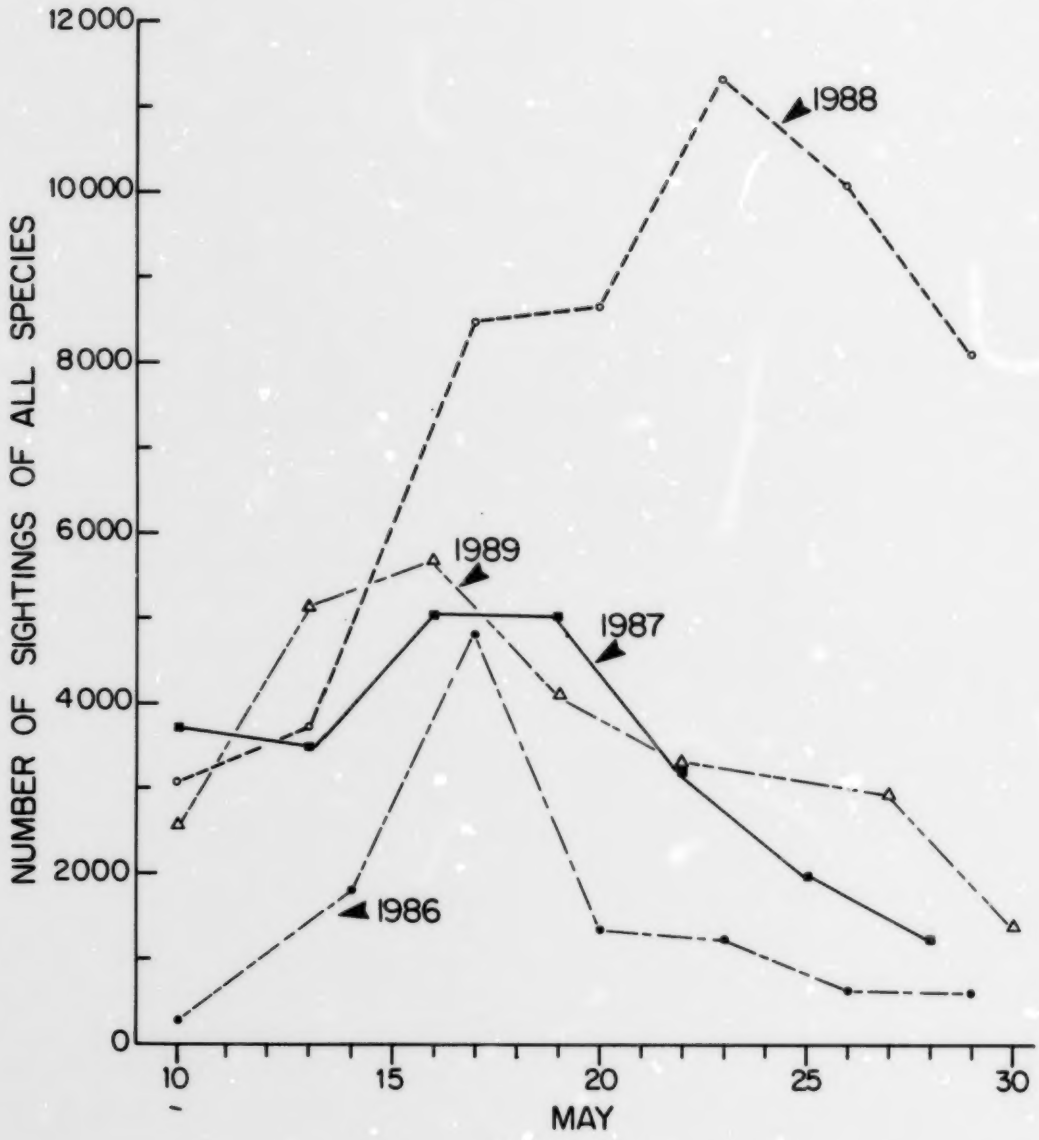

Figure 4. Temporal distribution of migrating waterfowl at six control sites between Yellowknife Bay and François Bay.

was made from data collected at six sites[6] which were the most used by waterbirds. If the 1988 curve is ignored[7], a slight yearly increase is evident in the number of waterbirds observed in the study area from 1986 to 1989. Although counts of spring migrants do not necessarily constitute good indicators of population trends, these figures nonetheless match current trends recorded in western populations of breeding waterfowl. These trends indicate that waterfowl populations are stable or increasing in northern areas (Dickson 1990).

4.2 Spatial and temporal distributions of spring migrants

The relative importance of the 14 sites surveyed was determined by an index of importance based on the occurrence of the ten most common bird species (Table 3) and is depicted in Figure 5. The lower Beaulieu River has remained the most important site regionally since 1986 (Appendix 3). Nearly 7 500 birds (over 20% of the total) were recorded there in 1989. Goulet and Campbell bays have remained second in importance for two consecutive years. These two contiguous bays provide good waterbird staging habitat because of their extensive, shallow wetlands.

The lower Yellowknife River ranked third among the 14 sites. As in the lower Beaulieu River, running water ensures that ice-free waters occur earlier than in nearby lakes or ponds. We also suspect that wetlands along these rivers are more productive, and therefore more attractive to wildlife, because of the continuous input of nutrients from upstream.

The area surveyed in 1989 represents less than half of the available habitat along the north shore of the North Arm. Wetlands

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[6] The sites are Drybones Bay, Cabin Islands, Matonabbee Bay, Devil's Channel, Goulet-Campbell bays, and the lower Beaulieu River.

[7] A late spring occurred in 1988 and unusually large flocks of waterbirds staged in the study area because relatively little open water was available elsewhere in the region.

Table 3. Percent abundance of the ten most common species observed at each open-water site between Yellowknife Bay and François Bay, Spring 1989.

	Species										IMP.
Site	SC	TS	CG	AW	NP	DU	CA	SS	GG	MA	INDEX
lower Yellowknife River	12.58	4.35	4.00	25.33	10.09	13.97	35.88	11.58	-	12.87	130.65
Wool Bay	6.37	0.23	-	0.48	0.15	1.45	2.13	2.93	-	3.14	16.88
Site B	4.44	3.10	-	2.69	1.85	1.89	0.76	2.24	-	5.24	22.21
Jackfish Cove	0.88	2.40	1.62	1.62	0.65	0.05	-	0.15	3.98	2.54	13.89
Moose Bay	0.68	0.24	-	0.32	-	0.24	-	0.23	-	1.05	2.76
Drybones Bay	6.44	4.76	26.02	8.61	17.68	5.17	5.94	4.40	5.57	8.53	93.12
Cabin Islands	4.14	10.80	1.55	6.44	11.18	6.62	2.29	4.94	10.51	10.63	69.10
Matonabbee Bay	2.36	11.27	16.72	5.50	17.21	8.90	0.11	2.32	7.96	6.29	78.64
Devil's Channel	7.17	12.14	8.23	3.88	0.44	7.16	4.53	12.05	4.78	3.14	63.52
Goulet-Campbell Bays	20.56	24.75	21.69	18.02	20.26	14.65	10.30	12.51	51.27	9.43	203.44
Site J	3.21	0.87	-	0.97	-	0.87	-	3.86	-	-	9.78
Site K	2.88	0.38	-	1.20	0.15	0.39	-	2.32	-	1.65	8.97
lower Beaulieu River	17.06	18.97	19.03	19.25	15.94	35.64	33.53	32.66	15.92	29.79	237.79
François Bay	11.23	5.74	1.14	5.69	4.39	3.00	4.53	7.80	-	5.69	49.21
Total number of records	8478	7002	4204	3091	2754	2068	1834	1295	1256	668	

SC - Unidentified scaup; CG - Canada Goose; NP - Northern Pintail; CA - Canvasback; GG - Greater White-fronted Goose;
TS - Tundra Swan; AW - American Wigeon; DU - Unidentified duck; SS - Surf Scoter; MA - Mallard.

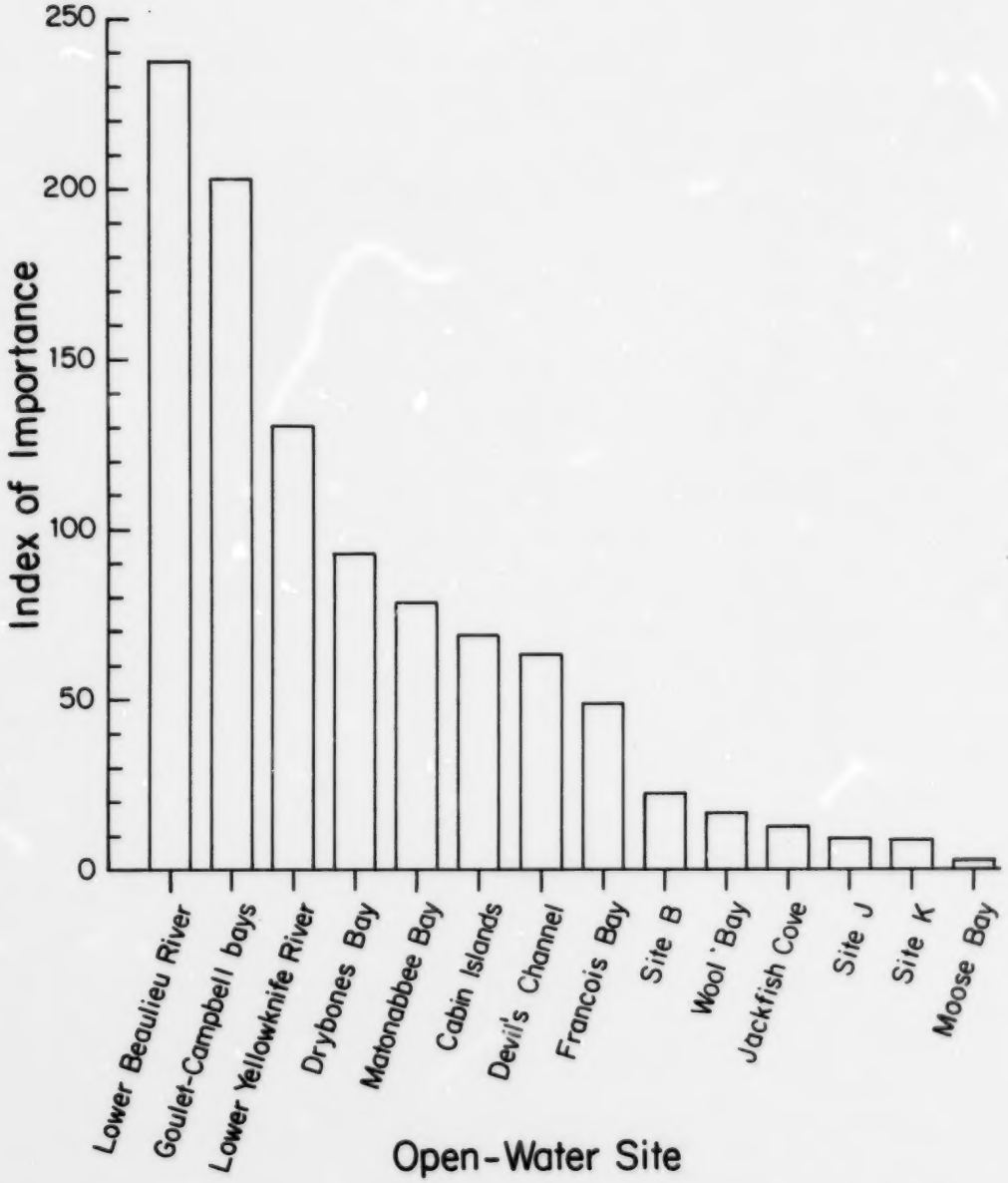

Figure 5. Relative importance of each open-water site to migrating waterfowl, Spring 1989.

and shallows also occur west of Yellowknife Bay, between Yellowknife Bay and Frank Channel, and on the south shore of the North Arm, between Frank Channel and Gypsum Point (Fig. 1). Thus, we suspect that at least twice the number of birds recorded in the study area may stage in the entire North Arm in the spring.

The temporal abundance of all species at all sites is presented in Table 4. Figure 4 shows temporal abundance only at the six most used sites. The pattern recorded in 1989 was similar to that of 1986 and 1987, but much different from that of 1988, a year when break-up was late. Some waterbirds arrived in April but there was little movement until the second week of May. Bird abundance peaked in mid-May and few migrants were left by the last week of May. Because numbers peaked in mid-May before colder-than-average temperatures (caused by northerly winds prevailed), the less favourable weather conditions of the last two weeks of May did not appear to delay the overall northward migration of waterbirds in this region.

5.0 CONCLUSION

Aerial surveys of staging waterfowl in the North Arm of Great Slave Lake were carried out in May 1989 for a fourth consecutive year. The sum of the peak numbers of each species recorded indicate that at least 9 368 birds representing 26 species of waterfowl staged between François Bay and Yellowknife Bay on 10-30 May. If a visibility correction factor of 2.0 is used for the small species, on 16 May, when migration peaked, there were nearly 7 700 small waterbirds in the study area. When geese and swans (not corrected for visibility) are added, over 11 000 waterbirds were present in the study area on that day alone. If we assume that this represents less than half of the waterbirds staging in the entire North Arm[8], the total number of waterbirds that staged there throughout the 1989 spring migration exceeds significantly the

[8] As suggested earlier, the study area encompasses less than half of the North Arm's wetlands.

Table 4. Temporal abundance of migrating species between Yellowknife Bay and François Bay, Spring 1989.

Species	May 10	13	16/17[a]	19	22	27	30
Red-throated Loon	-	-	-	2	-	-	3
Pacific Loon	-	7	3	6	-	-	-
Common Loon	3	23	17	19	5	6	5
Horned Grebe	6	-	1	1	-	1	3
Red-necked Grebe	47	218	29	24	30	25	30
Tundra Swan	620	1287	1168	1328	1344	997	258
Greater White-fronted Goose	180	522	540	14	-	-	-
Snow Goose	-	60	105	100	31	5	6
Canada Goose	96	360	1583	1273	474	393	25
Green-winged Teal	-	-	1	3	4	1	2
Mallard	157	75	84	109	69	77	97
Northern Pintail	248	250	651	500	304	590	211
Northern Shoveler	-	10	2	3	7	13	19
American Wigeon	677	703	426	376	349	304	256
Canvasback	166	1098	246	101	153	44	26
Redhead	-	-	2	-	3	-	-
Ring-necked Duck	12	10	7	10	14	-	20
Unidentified scaup	917	1717	1620	1278	1142	1084	720
Oldsquaw	-	-	-	-	16	30	24
Black Scoter	-	-	-	-	2	3	-
Surf Scoter	-	152	80	257	270	316	220
White-winged Scoter	-	-	-	-	-	-	2
Common Goldeneye	12	7	21	19	9	14	5
Bufflehead	22	51	36	6	44	42	64
Common Merganser	55	4	5	-	8	-	4
Red-broasted Merganser	8	32	58	50	55	156	145
Unidentified duck	278	501	509	118	196	347	119
Osprey	-	1	-	-	-	-	-
Bald Eagle	8	9	4	9	4	2	2
Red-tailed Hawk	-	1	-	-	-	-	-
American Coot	-	1	1	-	-	-	-
Parasitic Jaeger	-	-	-	-	-	-	6
Caspian Tern	-	-	-	-	2	2	4

[a] Fog occurred on 16 May and half of the sites were surveyed on 17 May.

criterion of 10 000 ducks, geese and swans used by the Ramsar Convention Bureau to identify Wetlands of International Significance (IUCN, no date).

Birds were particularly abundant in the lower Beaulieu River, at Goulet and Campbell bays and in the lower Yellowknife River. The 1989 spring migration was similar to those of 1986 and 1987 in terms of chronology and numbers of birds but unlike that of 1988, a year characterized by a late spring.

At least one percent of the national population of Tundra Swans staged in the study area for a third spring in four years. Accordingly, the designation of part of the North Arm of Great Slave Lake as a Key Habitat Site for this species in the Northwest Territories remains justified.

The highest numbers of Canvasbacks ever recorded in the study area and sightings of other "Prairie" species suggest that numerous birds displaced by drought occurred in the Great Slave Lake region in 1989.

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Appendix 1. Scientific names* of bird species mentioned in this report.

Common Name	Scientific Name	Code
Red-throated Loon	Gavia stellata	RL
Pacific Loon	Gavia pacifica	PL
Common Loon	Gavia immer	CL
Horned Grebe	Podiceps auritus	HG
Red-necked Grebe	Podiceps grisegena	RG
Tundra Swan	Cygnus columbianus	TS
Greater White-fronted Goose	Anser albifrons	GG
Snow Goose	Chen caerulescens	SG
Ross's Goose	Chen rossii	RO
Canada Goose	Branta canadensis	CG
Green-winged Teal	Anas crecca	GT
Mallard	Anas platyrhynchos	MA
Northern Pintail	Anas acuta	NP
Blue-winged Teal	Anas discors	BT
Cinnamon Teal	Anas cyanoptera	CI
Northern Shoveler	Anas clypeata	NS
Gadwall	Anas strepera	GA
American Wigeon	Anas americana	AW
Canvasback	Aythya valisineria	CA
Redhead	Aythya americana	RE
Ring-necked Duck	Aythya collaris	RD
Unidentified scaup	Aythya spp.	SC
Greater Scaup	Aythya marila	GS
Lesser Scaup	Aythya affinis	LS
Oldsquaw	Clangula hyemalis	OL
Black Scoter	Melanitta nigra	BS
Surf Scoter	Melanitta perspicillata	SS
White-winged Scoter	Melanitta fusca	WS
Common Goldeneye	Bucephala clangula	GO
Bufflehead	Bucephala albeola	BU
Common Merganser	Mergus merganser	CM
Red-breasted Merganser	Mergus serrator	RM
Ruddy Duck	Oxyura jamaicensis	RU
Unidentified duck		DU
Osprey	Pandion haliaetus	OS
Bald Eagle	Haliaeetus leucocephalus	BE
Red-tailed Hawk	Buteo jamaicensis	RH
American Coot	Fulica americana	AC
Wilson's Phalarope	Phalaropus tricolor	WP
Parasitic Jaeger	Stercorarius parasiticus	PJ
Caspian Tern	Sterna caspia	CT
Black Tern	Chlidonias niger	BL
Yellow-headed Blackbird	Xanthocephalus xanthocephalus	YB

* American Ornithologists' Union. 1983.

Appendix 2. Abundance of migrating species[a] between Yellowknife Bay and François Bay, Spring 1989.

Abundance of migrating species in the lower Yellowknife River, Spring 1989.

	SPECIES																											
Date	RL	PL	CL	HG	RG	TS	CG	MA	NP	NS	GT	AW	CA	RD	SC	SS	BS	RE	OL	GO	BU	CM	RM	DU	BE	RH	PJ	CT	Total
10 May			2	5	10	27		11	13			174	40	6	150					7	2	16		51					514
13 May			2		70	98		26	44	3		216	513		209	2					2		8	46	1	1			1241
16 May		3	16		12	46	20	20	85		1	118	39	5	363	8		2			9		18	84					849
19 May	2	6	10		10	90	120	7	30			105	8		261	37					1		6	22					715
22 May			3		10	20	1	11	48	1		78	37	6	21	77			2	2	7		5	2	2				333
27 May			3	1	11	24	27	4	42		1	42	21		44	26	3				6		31	76					362
30 May	1		3		2			7	16	1		50			19				12		4		8	8			6	2	139
Total	3	9	39	6	125	305	168	86	278	5	2	783	658	17	1067	150	3	2	14	9	31	16	76	289	3	1	6	2	4153

Abundance of migrating species at Wool Bay, Spring 1989.

	SPECIES																
Date	HG	RG	TS	MA	NP	NS	AW	CA	RD	SC	SS	RE	BU	CM	RM	DU	BE	Total
10 May		1		10														11
13 May		1					1											2
16 May		2		6				25		30			2					65
19 May				2		1	2			64	2							71
22 May		3	6				7	14		131	24	3		2	3	30		223
27 May		5	8	3	2		2			198	2		4		2		1	227
30 May	3	4	2		2		3		10	117	10				4			155
Total	3	16	16	21	4	1	15	39	10	540	38	3	6	2	9	30	1	754

Abundance of migrating species at Site B, Spring 1989.

	SPECIES														
Date	CL	RG	TS	MA	NP	AW	CA	RD	SC	SS	BU	RM	DU	BE	CT	Total
10 May			31	2	2	40	4		4			4	11			98
13 May		3	47	4	10	19		2	27		4	6	6	1		129
16 May			37	5		6	6		30	2	2		12			100
19 May	1		34	12	10	8			150	4	1		10	1		231
22 May			42	1	17	2	4		42	3						111
27 May		1	22		2	6			36			2			1	70
30 May		4	4	11	10	2			87	20	1	30				169
Total	1	8	217	35	51	83	14	2	376	29	8	42	39	2	1	908

Appendix 2. Continued.

Abundance of migrating species at Jackfish Cove, Spring 1989.

Date	SPECIES RG	TS	GG	SG	CG	MA	NP	AW	SC	SS	BU	DU	OS	BE	Total
10 May		29			2	7	2	10							50
13 May		30	50	20	30	2	2	6	10				1	1	152
16 May	2	28				2		4							36
19 May		17			6	6	4	9	10						52
22 May	1	37					10	7	50		2				107
27 May		27		4	30			10							71
30 May								4	5	2		1			12
Total	3	168	50	24	68	17	18	50	75	2	2	1	1	1	480

Abundance of migrating species at Moose Bay, Spring 1989.

Date	SPECIES RG	TS	MA	AW	SC	SS	RM	DU	Total
10 May			2	1					3
13 May				4					4
16 May									0
19 May		2	2		5	3			12
22 May		7	2					5	14
27 May		4	1	5	28		6		44
30 May	2	4			25				31
Total	2	17	7	10	58	3	6	5	108

Abundance of migrating species at Drybones Bay, Spring 1989.

Date	SPECIES CL	RG	TS	GG	SG	CG	MA	NP	NS	GT	AW	CA	SC	SS	BU	RM	DU	BE	AC	Total
10 May		2	18				21	35			33	55	46				10	6		226
13 May	1	13	68	30		8	1	12			13	42	182	12		3		2	1	388
16 May			72	40	45	757	4	217			66	2	63				60			1326
19 May			45			264	10	81	2		39		10					1		452
22 May			64			55	4	44	6		37		125	5	2		25	1		368
27 May			52			10	4	51	3		15		70	10		6	12			233
30 May	1	2	14				13	47	3	1	63	10	50	30						234
Total	2	17	333	70	45	1094	57	487	14	1	266	109	546	57	2	9	107	10	1	3227

Appendix 2. Continued.

Abundance of migrating species at Cabin Islands, Spring 1989.

	SPECIES																		
Date	RL	RG	TS	GG	CG	MA	NP	NS	GT	AW	CA	SC	SS	GO	BU	RM	DU	BE	Total
10 May		1	92			16	20			17		35			4		12	2	199
13 May		15	78	130	20	3	13	2		46	40	40					50	1	438
16 May			105			18	115			82		40			2		14		376
19 May		2	145	2		12	56			26	2	69	22	1	2		20	1	360
22 May		3	148		25	10	18		1	8		128	2			2	2	1	348
27 May		4	149		20	11	30	8		8		34	10			4	15	1	294
30 May	2	4	39			1	56	2		12		5	30			27	24		202
Total	2	29	756	132	65	71	308	12	1	199	42	351	64	1	8	33	137	6	2217

Abundance of migrating species at Matonabee Bay, Spring 1989.

	SPECIES																			
Date	CL	RG	TS	GG	SG	CG	MA	NP	NS	GT	AW	CA	SC	SS	BU	RM	DU	BE	CT	Total
10 May			63			12	5	62			34						12			188
13 May		26	69		40	130	1				3		110	10			2	1		392
16 May			196	100	60	80	2	171			13		10		4		115			751
19 May			188		80	210	12	120			72		19	2		13	2	2		720
22 May	1	2	130		30	95	10	7		1	7	2	29	4	2	2	20		2	344
27 May			108		1	156		110			15		30		4	4	30		1	459
30 May			35		6	20	12	4	4		26		2	14	4	22	3		2	154
Total	1	28	789	100	217	703	42	474	4	1	170	2	200	30	14	41	184	3	5	3008

Abundance of migrating species at Devil's Channel, Spring 1989.

	SPECIES																					
Date	CL	HG	RG	TS	GG	SG	CG	MA	NP	NS	AW	CA	RD	SC	SS	GO	BU	CM	RM	DU	BE	Total
10 May				68			32	7	8		16						2	3		5		141
13 May				131			80	5			23	57		56			11			20		383
16 May				88	60		100	4			8					4			4	70	1	339
19 May		1		132		20	60				17	20		114					6	3		373
22 May			4	198			4		4		13	4		171	37		2		7			444
27 May			1	196			70	5			17			187	117				4	50		647
30 May	1			37						8	26	2	2	80	2		9		6			173
Total	1	1	5	850	60	20	346	21	12	8	120	83	2	608	156	4	24	3	27	148	1	2500

Appendix 2. Continued.

Abundance of migrating species at Goulet - Campbell bays, Spring 1989.

Date	SPECIES																			Total
	CI	HG	RG	TS	GG	SG	CG	MA	NP	MS	AW	CA	SC	SS	BU	RM	DU	BE	AC	
10 May			2	210	120		20	27	79		229	18	127		6		34			872
13 May			6	419	312			3	83		177	60	410		6	2	40	2		1520
17 May		1	4	333	200		306	3	41		25	72	447	2	2	4	60	1	1	1502
19 May	3		1	373	12		315	5	133		10	6	317	39		2	22	1		1239
22 May			4	274		1	271	1	35		50	31	328	52	4	19				1070
27 May	1			89				14	179	2	35		46	25		9	102			502
30 May			5	35				10	8		31	2	68	44	3	12	45	2		265
Total	4	1	22	1733	644	1	912	63	558	2	55	189	1743	162	21	48	303	6	1	6970

Abundance of migrating species at Site J, Spring 1989.

Date	SPECIES							Total
	RG	TS	AW	SC	SS	BU	DU	
10 May							3	3
13 May				120				120
17 May		3		6		2		11
19 May	2	7	4	20				33
22 May		17	14	41		2		74
27 May		34	2	65	30			131
30 May			10	20	20	3	15	68
Total	2	61	30	272	50	7	18	440

Abundance of migrating species at Site K, Spring 1989.

Date	SPECIES										Total
	TS	MA	NP	AW	SC	SS	BU	RM	DU	BE	
10 May	1	5	2	2					6		16
13 May	1	2		12	6			3			24
17 May	4	1		2	41				2	1	51
19 May	3			5	17						25
22 May	4			8	2		2				16
27 May	12	3		8	76	10	3				112
30 May	2		2		102	20	2	1			129
Total	27	11	4	37	244	30	7	4	8	1	373

Appendix 2. Continued.

Abundance of migrating species in the lower Beaulieu River, Spring 1989.

	SPECIES																							
Date	PL	CL	HG	RG	TS	GG	CG	MA	NP	NS	GT	AW	CA	RD	SC	SS	BS	OL	GO	BU	CM	RM	DU	BE	Total
10 May		1	1	31	73	60		33	2			93	49	6	455				5	8	34		134		985
13 May	7	20		84	270		77	28	64	3		156	386	8	393	124			7	26	4	8	333		1998
17 May		1		9	220	140	320	18	22	2		98	96	2	282	45			17	9	5	20	70	1	1377
19 May		5		6	218		298	35	53		3	52	55	10	110	146			16			17	17	1	1042
22 May		1		3	313		20	30	117		2	87	10	8	26	40	2		7	19	6	14	112		817
27 May		2		3	160		80	28	124			98	11		114	56			14	22		72	50		834
30 May				5	74		5	27	57	1	1	11	8	8	66	12		12	5	35	4	33	21		385
Total	7	30	1	141	1328	200	800	199	439	6	6	595	615	42	1446	423	2	12	71	119	53	164	737	2	7438

Abundance of migrating species at François Bay, Spring 1989.

	SPECIES																	
Date	RG	TS	CG	MA	NP	NS	AW	CA	SC	SS	OL	WS	GO	BU	CM	RM	DU	BE	Total
10 May		8	30	11	23		28		100						2	4			206
13 May		76	15		22	2	27		154	4				2		2	4		308
17 May		36		1			4	6	308	23				4		12	22		416
19 May	3	74		6	13		27	10	112	2			2	2		6	22	2	281
22 May		84	3		4		31	51	48	26	14			2		3			266
27 May		112		4	50		41	12	156	30	30			3		16	12		466
30 May	2	12		16	9		18	4	74	16		2		3		2	2		160
Total	5	402	48	38	121	2	176	83	952	101	44	2	2	16	2	45	62	2	2103

[a] Species codes in Appendix 1.

Appendix 3. Relative importance and amount of open water at each staging site, 1986-1989.

Site	Relative importance[a] 1989	1988	1987	1986	Amount of open water (km)[b]
Lower Beaulieu River	1	1	1	1	24.0
Goulet-Campbell bays	2	2	3	4	12.5
Lower yellowknife River	3	n[c]	n	n	10.0
Drybones Bay	4	6	8	8	12.5
Matonabbee Bay	5	4	2	7	8.0
Cabin Islands	6	3	4	3	7.7
Devil's Channel	7	7	5	2	6.0
François Bay	8	5	7	5	9.5
Site B	9	8	6	6	4.5
Wool Bay	10	11	10	10	3.0
Jackfish Cove	11	9	11	11	3.5
Site J	12	13	12	12	4.5
Site K	13	12	13	14	4.5
Moose Bay	14	14	14	13	3.5
Thor Lake Study Site	n	10	9	9	36.0[d]

[a] Relative importance determined by Index of Importance, see Methods.
[b] Length of open-water transect remained constant during the study period but width increased as ice receded; see Table 1.
[c] n = not surveyed.
[d] Included open waters, ice and land.